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Alfalfa Hay-Concentrate, Complete Corn Silage-Concentrate, or Complete Alfalfa Silage-Concentrate Diets for Dairy Calves

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Alfalfa Hay-Concentrate, Complete Corn Silage-Concentrate, or Complete Alfalfa Silage-Concentrate Diets for Dairy Calves

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INTRODUCTION

Maximum utilization of home grown roughages, properly supplemented with cereal grains or their by-products and minerals to produce satisfactory performance, is an economical approach to feeding post-weaning calves (1).

Based on convenience in feeding, especially in automated feeding systems, there is considerable interest in complete mixed diets for cattle, where both roughage and concentrate are mixed together and fed as a single feed containing all the nutrients required for the performance expected.

In the experiments reported here, growth and other measures of performance were measured in calves from 16-26 weeks of age fed complete corn silage or complete alfalfa silage diets, where the concentrate was mixed with the roughage either at feeding time or at time of ensiling. These complete diets were compared with high quality alfalfa hay-concentrate diets containing approximately 70% roughage and 30% concentrate, shown in previous experiments to produce satisfactory growth after weaning from milk at 7 weeks (2, 3, 4, 5, 6).

EXPERIMENTAL PROCEDURE

Experiment 1

The Holstein and Jersey calves used in this and the following two experiments had been fed complete high roughage pelleted diets from 2 to 16 weeks of age. They were weaned from milk at 7 weeks. From 16-26 weeks of age, the calves in Experiment 1, group 1 (14 Holsteins and 8 Jerseys), were fed a complete corn silage-concentrate diet free choice. The concentrate was mixed with the corn silage at feeding time in a ratio of 7 parts of wet corn silage to 1 part concentrate by weight. These calves were compared with 16 Holstein and 6 Jersey control calves in group 2 fed loose alfalfa hay free choice. Concentrate was limited to a 2:1 hay to concentrate ratio with a 1.8 kg/d concentrate limit for Holsteins and a 1.4 kg/d limit for Jerseys. Group 3 (18 Holsteins and 10 Jerseys), fed similarly to the control calves but at a different time, is included for comparison.

The percentage of ingredients and composition (dry basis) of all three diets as consumed are shown in Tables 1 (Holsteins) and 2 (Jerseys). Also included in Tables 1 and 2 are: 1) ration dry matter percent as fed; 2) dry roughage percent and dry concentrate percent in the diets; 3) roughage:concentrate ratio; 4) estimated net energy (ENE), Mcal/100 kg (see footnote Tables 1 and 2 for method of calculation); 5) percent TDN, calculated from ENE (see footnote Tables 1 and 2); 6) percent protein; 7) percent digestible protein calculated from total protein (see footnote Tables 1 and 2); and 8) nutritive ratio (see footnote Tables 1 and 2 for method of calculation). The above information also is included in Tables 1 and 2 for all of the diets in experiments 2 and 3.

Criteria used to measure and compare calf performance were: 1) dry matter (DM) intake; 2) ENE intake; 3) body weight gain; 4) withers height gain; 5) efficiency of gain (DM intake/kg BW gain) and (ENE/kg BW gain); 6) feed ingredient costs based both on retail feed ingredient values and on farm production feed ingredient costs for alfalfa hay and silage, corn silage, and shelled corn; and 7) feed ingredient costs/kg gain.

Feed ingredient values used in calculating feed ingredient costs, both retail and those based on farm production costs for all three experiments, are shown in Table 5.

Experiment 2

From 16-26 weeks, the calves in group 1 (10 Holsteins and 0 Jerseys) were fed a complete corn silage-concentrate diet. The concentrate was mixed with fresh chopped whole corn plant at time of ensiling in the ratio of 7 parts of whole corn plant to 1 part concentrate.

The calves in group 2 (12 Holsteins and 8 Jerseys) were fed a complete alfalfa silage-concentrate diet where the concentrate (1 part) had been mixed with freshly chopped alfalfa (2 parts) at time of ensiling.

The percentage of ingredients and composition (dry basis) of the diets as consumed are shown in Tables 1 (Holsteins) and 2 (Jerseys) as described in experiment 1. Criteria used to measure calf performance were the same as described in experiment 1 except that gain in width at the hook bones was used as a measure of skeletal growth instead of gain in withers height.

Experiment 3

From 16-26 weeks, the calves in group 1 (8 Holsteins and 0 Jerseys) were fed a complete corn silage-concentrate diet free choice. The concentrate was mixed with the silage at feeding time in a ratio of 7 parts of wet corn silage to 1 part concentrate.

TABLE 1.—Comparison of Diets Fed to Holsteins, 16-26 Weeks of Age.

Experiment No.	1	1	1-A	2	2	3	3	3	3-A
Diet Description	**Complete corn silage-concentrate***	**Alfalfa hay-concentrate**	**Alfalfa hay-concentrate**	**Complete corn silage-concentrate†**	**Complete alf. silage-concentrate†**	**Complete corn silage-concentrate***	**Complete chopped alf.-concentrate (wet mix)**	**Alfalfa hay-concentrate**	**Alfalfa hay-concentrate**
Diet or Group No.	1	2	3	1	2	1	2	3	4
Diet Composition (consumed)					**Percent (Dry Basis)**				
Corn silage	71.7			72.5		78.3			
Alfalfa hay		72.0	72.4				50.0	73.7	68.6
Dehydrated alfalfa				1.5		3.9			
Alfalfa silage					69.7				
Shelled corn (gr.)	13.0	14.0	12.1	15.6	28.7	12.3	36.5	13.1****	15.7****
Oats (gr.)		5.6	9.2					5.3††††	6.3††††
Wheat bran			3.0						
Soybean meal	14.1	7.5	3.0	8.2			12.0	7.2	8.6
Urea				1.0		1.9			
Bone meal	0.9	0.6		0.9				0.5	0.6
Di Ca PO_4						1.5			
Diammonium PO_4					1.2		1.0		
Mono Na PO_4						0.1			
Na Meta bi-sulfite						0.02			
Limestone						2.0			
Salt	0.3	0.3	0.3	0.3	0.4		0.5	0.2	0.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Further Diet Comparisons									
Dry matter, as fed (%)	38.9	88.0***	88.0***	38.2	51.6	36.3	35.5	88.0***	88.0***
Concentrate in diet (%)‡	57.0‡‡	28.0	27.6	55.1‡‡	30.3	49.2‡‡	50.0	26.3	31.4
Roughage in diet (%)‡	43.0	72.0	72.4	44.9	69.7	50.8	50.0	73.7	68.6
Roughage:concentrate ratio‡	0.75:1	2.57:1	2.62:1	0.82:1	2.30:1	1.03:1	1.00:1	2.80:1	2.19:1
Est. net energy (mcal/100 kg)‡, †††	128	103	104	135	111	132	110	101	113
TDN (%)‡	66.6	58.2	58.8	68.9	61.1	67.9	60.7	57.8	61.7
Total protein (%)‡	13.9	17.1	16.4	14.2	16.9	15.6	17.3	18.4	18.0
Digestible protein (%)‡, **	9.4	12.4	11.8	9.7	12.2	11.0	12.6	13.6	13.2
Nutritive ratio‡, ††	1:6.09	1:3.69	1:3.98	1:6.10	1:4.01	1:5.17	1:3.82	1:3.25	1:3.67

*Concentrate added at feeding time.
†Concentrate added at time of ensiling.
‡Dry basis.
**Percent digestible protein=(% total protein x .93) —3.5 (7).
††Nutritive ratio=(% TDN — % dig. protein) ÷ % dig. protein (8).
‡‡Includes estimated corn kernels in corn silage, 40% of dry matter.
***Percent dry matter estimated.
†††ENE (mcal/d)=ENE_m (mcal/d) + ENEg (mcal/d).
ENE_m (mcal/d)=70 x median $BW^{0.75}_{kg}$ (16-26 wk).
ENEg (mcal/d)=2.06 mcal x av. kg gain/d (16-26 wk).
‡‡‡Percent TDN=(ENE (mcal/100 kg diet) + 76.2) ÷ 3.065 (9).
****Burr milled shelled corn.
††††Crimped oats.

The calves in group 2 (12 Holsteins and 0 Jerseys) were fed a complete mixed feed consisting of equal parts of chopped alfalfa hay and concentrate. Three parts of water were added to 2 parts of the mixed chopped hay and concentrate. The wet mix was allowed to soak between feedings. The resulting mixture had a dry matter content similar to the complete silage-concentrate mixtures (35.5% DM), was dust free, soft-textured, and had been shown in preliminary trials to be highly palatable to calves.

The calves in group 3 (18 Holsteins and 6 Jerseys) were fed high quality alfalfa hay free choice. Concentrate was limited to a 2:1 hay to grain ratio with a 1.8 kg/d concentrate limit for Holsteins and a 1.4 kg/d limit for Jerseys.

Group 4 calves (21 Holsteins and 0 Jerseys) were fed an alfalfa hay-concentrate diet similar to group 3 except at a different time and at a different location (see footnote Table 3) and are included with experiment 3 for comparison with group 3 and groups 2 and 3, experiment 1, all fed a similar diet.

The percentage of ingredients and composition (dry basis) of the diets as consumed are shown in Tables 1 (Holsteins) and 2 (Jerseys) as described in experiment 1.

Criteria used to measure calf performance were the same as described in experiment 1.

TABLE 2.—Comparison of Diets Fed to Jerseys, 16-26 Weeks of Age.

Experiment No.	1	1	1A	2	3
Diet Description	Complete corn silage-concentrate*	Alfalfa hay-concentrate	Alfalfa hay-concentrate	Complete alf. silage-concentrate†	Alfalfa hay-concentrate
Diet or Group No.	1	2	3	2	3
Diet Composition (consumed)			Percent (Dry Basis)		
Corn silage	71.7				
Alfalfa hay		70.8	70.4		73.9
Dehydrated alfalfa					
Alfalfa silage				69.7	
Shelled corn (gr.)	13.0	14.6	13.0	28.7	13.0‡
Oats (gr.)		5.8	9.8		5.2**
Wheat bran			3.2		
Soybean meal	14.1	7.9	3.3		7.2
Urea					
Bone meal	0.9	0.6			0.5
Di Ca PO_4					
Diammonium PO_4				1.2	
Mono Na PO_4					
Na meta bi-sulfite					
Limestone					
Salt	0.3	0.3	0.3	0.4	0.2
TOTAL	100.0	100.0	100.0	100.0	100.0
Further Diet Comparisons					
Dry matter, as fed (%)	38.9	88.0***	88.0***	51.6	88.0**
Concentrate in diet (%)‡	57.0‡‡	29.2	29.6	30.3	26.1
Roughage in diet (%)‡	43.0	70.8	70.4	69.7	73.9
Roughage:concentrate ratio‡	0.75:1	2.42:1	2.38:1	2.30:1	2.83:1
Est. net energy (mcal/100 kg)‡, †††	129	100	98	109	98
TDN (%)‡	66.9	57.5	56.8	60.4	56.8
Total protein (%)‡	13.9	17.1	16.4	16.9	18.4
Digestible protein (%)‡, **	9.4	12.4	11.8	12.2	13.6
Nutritive ratio‡, ††	1:6.12	1:3.64	1:3.81	1:3.95	1:3.18

*Concentrate added at feeding time.
†Concentrate added at time of ensiling.
‡Dry basis.
**Percent digestible protein = (% total protein x .93) —3.5 (7).
††Nutritive ratio = (% TDN — % dig. protein) ÷ % dig. protein (8).
‡‡Includes estimated corn kernels in corn silage, 40% of dry matter.
***Percent dry matter estimated.
†††ENE (mcal/d) = ENE_m (mcal/d) + ENEg (mcal/d).
ENE_m (mcal/d) = 70 x median $BW^{0.75}_{kg}$ (16-26 wk).
ENEg (mcal/d) = 2.06 mcal x av. kg gain/d (16-26 wk).
‡‡‡Percent TDN = (ENE (mcal/100 kg diet) + 76.2) ÷ 3.065 (9).
****Burr milled shelled corn.
††††Crimped oats.

TABLE 3.—Performance of Holstein Calves from 16 to 26 Weeks of Age Fed Either Complete Corn Silage-Concentrate, Alfalfa Hay-Concentrate or Complete Alfalfa Silage-Concentrate Diets with Concentrates Mixed Either at Feeding Time or at Time of Ensiling.

Experiment No.	1	1	1-A	2	2	3	3	3	3-A
Diet Description	Complete corn silage-concentrate*	Alfalfa hay-concentrate	Alfalfa hay-concentrate	Complete corn silage-concentrate†	Complete alf. silage-concentrate†	Complete corn silage-concentrate*	Complete chopped alf.-concentrate (wet mix)	Alfalfa hay-concentrate	Alfalfa hay-concentrate
Diet or Group No.	1	2	3	1	2	1	2	3	4
No. of calves	14	16	18	10	12	8	12	18	21***
DM intake 16-26 wk (kg)	264a‡‡	343b	315	227a	276b	252a	316b	372c	302
ENE intake 16-26 wk (mcal)	339	353	326	306	307	332	349	377	340
Initial body wt 16 wk (kg)	109	116	112	116	123	118	108	121	113
Body wt 26 wk (kg)	175	185	172	167	171	178	179	197	178
Body wt gain 16-26 wk (kg)	66a	69a	60	51a	48b	60a	71b	76b	65
Av. daily gain 16-26 wk (kg)	0.95	0.99	0.86	0.73	0.69	0.86	1.01	1.09	0.93
Withers ht gain 16-26 wk (cm)	10.2a	10.9a	10.0			10.1a	11.2a	11.1a	11.5
Width at hooks gain 16-26 wk (cm)				3.4a	4.1a				
DM/kg BW gain 16-26 wk (kg)	4.00	4.97	5.25	4.45	5.75	4.20	4.45	4.89	4.65
ENE/kg BW gain 16-26 wk (mcal)‡	5.14	5.12	5.40	6.00	6.40	5.53	4.92	4.96	5.23
Feed costs 16-26 wk ($)**	24.50	28.68	24.85	19.66	21.45	19.43	30.90	30.73	25.94
Feed costs 16-26 wk ($)††	19.58	23.91	20.57	15.25	16.83	14.24	25.98	25.59	21.80
Feed costs/kg gain 16-26 wk ($)**	0.37	0.42	0.41	0.39	0.45	0.32	0.44	0.40	0.40
Feed costs/kg gain 16-26 wk ($)††	0.30	0.35	0.34	0.30	0.35	0.24	0.38	0.34	0.34

*Concentrate added at feeding time.
†Concentrate added at time of ensiling.
‡Feed costs based on Ohio Crop Enterprise Budgets 1977, Extension publication MM-367, where available. Other costs obtained from other sources (see Table 5).
**Feed costs used based on purchase or sale value (see Table 5).
††Feed costs used based on farm production costs (see Table 5).
‡‡Letters differing within experiment indicate significant differences ($P<.05$). Analysis of variance.
***Heifers fed at N. C. Branch.

RESULTS AND DISCUSSION

Experiment 1

The performance of the calves from 16-26 weeks fed diets 1, 2, and 3 is compared in Tables 3 (Holsteins) and 4 (Jerseys). In both Jerseys and Holsteins, dry matter intake was significantly lower in diet group 1 (corn silage-concentrate) than in group 2 (alfalfa hay-concentrate). However, body weight and withers height gains were not significantly different between these groups, reflecting more closely the similar ENE intake than the dry matter intake, which was significantly higher in group 2.

Since digestible protein intake exceeded the National Research Council (NRC) requirement in both groups 1 and 2, protein was not likely a limiting factor for growth. In digestion trials conducted using two male Jerseys 5 months old, average protein digestibility was 73.3%. Nitrogen digestibility in group 2 was not measured.

The differences in dry matter intake and the similarity of ENE intake were also reflected in the efficiency of gain. DM/kg BW gain in group 2 was 24% higher for Holsteins and 33% higher for Jerseys than in group 1; whereas, the ENE/kg BW gains between the two diet groups were nearly identical.

Both total feed ingredient costs and costs/kg gain were higher for group 2 than for group 1 (Tables 3 and 4). Feed ingredient costs (Tables 3 and 4) based on farm production costs, where appropriate, compared to retail costs for all ingredients were 20% lower in both Holsteins and Jerseys for diet group 1 and 17% lower in diet group 2. Similar differences existed in feed costs/kg gain.

The Holstein calves in group 3 (Table 3), shown only for comparison, ate less dry matter and gained less than the calves in group 2 fed a similar diet. The Jersey calves in group 3 (Table 4) performed similarly to the Jerseys in group 2.

The similarity of growth performance by the calves in group 1 compared to groups 2 and 3 emphasized the high concentrate (57% concentrate in group 1) required for equal performance when corn silage is fed compared to the alfalfa-based diets (28% concentrate in groups 2 and 3).

Feed ingredients costs/kg gain based on both farm production costs and retail costs were lower for the complete corn silage-concentrate diet (group 1).

Experiment 2

The performance of the calves from 16-26 weeks fed diets 1 and 2 is compared in Table 3 (Holsteins) and Table 4 (Jerseys, diet 2 only). In the Holsteins, dry matter intake was significantly higher for diet 2 (complete alfalfa silage-concentrate, mixed at time

TABLE 4.—Performance of Jersey Calves from 16 to 26 Weeks of Age Fed Either Complete Corn Silage-Concentrate, Alfalfa Hay-Concentrate or Complete Alfalfa Silage-Concentrate Diets with Concentrate Mixed Either at Feeding Time or at Time of Ensiling.

Experiment No.	1	1	1-A	2	3
Diet Description	Complete corn silage-concentrate*	Alfalfa hay-concentrate	Alfalfa hay-concentrate	Complete alf. silage-concentrate†	Alfalfa hay-concentrate
Diet or Group No.	1	2	3	2	3
No. of calves	8	6	10	8	6
DM intake 16-26 wk (kg)	191a‡‡	244b	244	200	272
ENE intake 16-26 wk (mcal)	246	244	240	218	267
Initial body wt 16 wk (kg)	65	67	71	75	74
Body wt 26 wk (kg)	115	115	116	110	128
Body wt gain 16-26 wk (kg)	50a	48a	45	35	54
Av. daily gain 16-26 wk (kg)	0.71	0.69	0.64	0.50	0.77
Withers ht gain 16-26 wk (cm)	10.9a	12.2a	11.0		8.9
Width at hooks gain 16-26 wk (cm)				3.7	
DM/kg BW gain 16-26 wk (kg)	3.82	5.08	5.42	5.72	5.04
ENE/kg BW gain 16-26 wk (mcal)	4.92	5.08	5.33	6.23	4.94
Feed costs‡ 16-26 wk ($)**	17.73	20.62	19.54	15.54	22.49
Feed costs 16-26 wk ($)††	14.17	17.25	16.25	12.20	18.69
Feed costs/kg gain 16-26 wk ($)**	0.36	0.43	0.43	0.44	0.42
Feed costs/kg gain 16-26 wk ($)††	0.28	0.36	0.36	0.35	0.35

*Concentrate added at feeding time.
†Concentrate added at time of ensiling.
‡Feed costs based on Ohio Crop Enterprise Budgets 1977, Extension publication MM-367, where available. Other costs obtained from other sources (see Table 5).
**Feed costs used based on purchase or sale value (see Table 5).
††Feed costs used based on farm production costs (see Table 5).
‡‡Letters differing within experiment indicate significant differences ($P<.05$). Analysis of variance.

TABLE 5.—Feed Ingredient Values Used, Dry Matter Basis.

	Retail Value	Farm Production Costs
	$/kg	$/kg
Alfalfa hay	0.066	0.051
Alfalfa silage	0.066	0.051
Dehydrated alfalfa	0.114	
Corn silage	0.066	0.044
Shelled corn	0.095	0.073
Oats	0.088	0.088
Soybean meal	0.220	
Wheat bran	0.158	
Urea	0.220	
Bone meal	0.205	
Limestone	0.037	
Salt	0.064	
Duofos	0.341	
Diammonium PO_4	0.341	
Mono Na PO_4	0.264	
Di Cal PO_4	0.262	

of ensiling) than for diet 1 (complete corn silage-concentrate, mixed at time of ensiling).

The higher dry matter intake of diet 2 resulted in a significant increase in body weight gain and an insignificant increase in width at hooks gain compared to diet 1. However, the ENE intake of the two diets was nearly identical. ENE intake was lower in both diets 1 and 2 than in any of the other diets used in either experiments 1 or 3. This was reflected in comparatively lower body weight gains and average daily gains in experiment 2 than in the other two experiments.

As digestible protein intake exceeded NRC requirements in both groups 1 and 2, it is not likely that protein limited growth in this experiment. In diet 1, nitrogen digestibility was 77.5% and dry matter digestibility was 78.1%. In diet 2, nitrogen digestibility was 60.5% and dry matter digestibility was 69.3% (average of three trials using 5-6 month old male Jerseys).

The higher dry matter intake of the calves fed diet 2 resulted in 30% lower efficiency of gain calculated as DM/kg BW gain compared to diet 1. ENE/kg BW gain differences (7%) were small.

Both retail and farm production feed ingredient costs were approximately 10% higher for diet 2 than for diet 1. Feed ingredient costs based on farm production costs were about 22% lower than the retail ingredient costs for both diets. Feed costs/kg gain were approximately 14% lower for diet 1 (complete corn silage-concentrate) than for diet 2 (complete alfalfa silage-concentrate). The use of farm production costs for shelled corn, corn silage, and alfalfa silage resulted in 23% less feed ingredients costs/kg of gain than when retail values were used. The data for Jerseys fed only diet 2 are recorded in Table 4.

Although the roughage to concentrate ratios in diets 1 and 2, experiment 2, were similar to those in diets 1 and 2, experiment 1 (Table 1), the calves (both Jerseys and Holsteins) fed the complete ensiled diets, experiment 2, did not eat as much dry matter or grow as well as those fed similar complete diets where the concentrate was mixed at feeding time and the alfalfa was fed as hay rather than silage. These results are consistent with those of Pratt *et al* (10), who showed depressed feed intake when all fermented high moisture grass-legume silage diets were fed to lactating cows.

Experiment 3

Performance of the calves in experiment 3 from 16-26 weeks fed diets 1, 2, 3, and 4 is also shown in Tables 3 (Holsteins) and 4 (Jerseys, diet 3 only). In this experiment, the complete corn silage-concentrate, diet 1, and the complete chopped alfalfa-concentrate, wet mix, diet 2, were both made from equal parts of concentrate (including the kernels in corn silage) and roughage. Diets 3 and 4 were similar to diets 2 and 3 (experiment 1).

The Holstein calves fed diet 1, complete corn silage-concentrate, mixed at feeding time, consumed significantly less dry matter and gained in body weight at a significantly lower rate than the calves fed diets 2 or 3. There were no significant differences in withers height gain among the groups, although the average withers height gain for the calves fed diet 1 was 1 cm less than diets 2 or 3. Despite the lower dry matter intake in group 1, digestible protein intake exceeded the NRC requirement, suggesting that protein was not a limiting factor on growth.

As in experiments 1 and 2, the complete corn silage-concentrate diet (diet 1) was the most efficient measured as DM/kg BW gain. However, ENE efficiency was less for the corn silage-concentrate diet (diet 1) in this experiment, perhaps due to the lower percent concentrate in the corn silage based diet and the higher percent concentrate in the alfalfa based diets.

As in the other experiments, the corn silage based diet was lower in total feed ingredient costs—37% lower based on retail feed ingredient costs and 45% lower based on farm production costs. Reductions in total feed ingredient costs using farm production costs compared to retail values were 27% (diet 1), 16% (diet 2), 17% (diet 3), and 15% (diet 4). The corn silage based diet (diet 1) resulted in less feed costs/kg gain (more than 20% less based on retail values and more than 30% less based on farm production costs) than the alfalfa based diets as was also ob-

served in experiments 1 and 2. The feed costs/kg gain also were lower for diet 1, experiment 1, than any of the other corn silage based diets in experiments 1 or 2, probably because of the lower percentage concentrate. Reductions in feed ingredient costs/kg gain due to use of farm production costs compared to retail values were 25% (diet 1), 14% (diet 2), and 15% (diets 3 and 4).

Jersey performance data using diet 3 only are shown in Table 4.

CONCLUSIONS

Where direct comparisons were made, dry matter intake was consistently higher when the alfalfa based diets, either silage or hay, were fed than when corn silage based diets were fed. All groups consumed more protein than NRC requirements; thus protein likely did not limit growth in any group. The excess protein above NRC requirements was less in the corn silage based diets and consequently the nutritive ratios were wider than in the alfalfa based diets.

ENE intake differences were less marked than dry matter intake differences and were more nearly reflective of differences in body weight gain. Body weight gains were lowest (average 0.71 kg/d) in the Holstein groups fed the complete ensiled diets where the concentrate was mixed with the fresh chopped forage (whole corn plant or alfalfa) at the time of ensiling (experiment 2). Body weight gains for Holsteins fed all the other diets averaged 0.96 kg/d, which is an acceptable rate of gain for Holstein calves 4-6 months of age (11). Average daily gain for Jerseys fed all diets except the complete ensiled diet 3, experiment 3, was 0.70 kg/d which is also an acceptable rate of gain for Jerseys 4-6 months of age (11). Body weight gains were somewhat higher when the alfalfa hay-concentrate diets were fed (0.97 kg/d average for Holsteins) than when corn silage-concentrate diets were fed (average 0.92 kg/d for Holsteins). However, the alfalfa based diets were consistently more costly based both on total feed ingredient costs, 16-26 wk, and/or feed ingredient costs/kg gain.

Considerable savings in feed costs were shown when feed ingredient costs were calculated using farm production costs for corn, alfalfa hay, alfalfa silage, and corn silage than when retail values were used. This emphasizes the importance of utilizing home grown feeds where feasible to keep down costs of raising herd replacements.

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BETTER LIVING IS THE PRODUCT

of research at the Ohio Agricultural Research and Development Center. All Ohioans benefit from this product.

Ohio's farm families benefit from the results of agricultural research translated into increased earnings and improved living conditions. So do the families of the thousands of workers employed in the firms making up the state's agribusiness complex.

But the greatest benefits of agricultural research flow to the millions of Ohio consumers. They enjoy the end products of agricultural science—the world's most wholesome and nutritious food, attractive lawns, beautiful ornamental plants, and hundreds of consumer products containing ingredients originating on the farm, in the greenhouse and nursery, or in the forest.

The Ohio Agricultural Experiment Station, as the Center was called for 83 years, was established at The Ohio State University, Columbus, in 1882. Ten years later, the Station was moved to its present location in Wayne County. In 1965, the Ohio General Assembly passed legislation changing the name to Ohio Agricultural Research and Development Center—a name which more accurately reflects the nature and scope of the Center's research program today.

Research at OARDC deals with the improvement of all agricultural production and marketing practices. It is concerned with the development of an agricultural product from germination of a seed or development of an embryo through to the consumer's dinner table. It is directed at improved human nutrition, family and child development, home management, and all other aspects of family life. It is geared to enhancing and preserving the quality of our environment.

Individuals and groups are welcome to visit the OARDC, to enjoy the attractive buildings, grounds, and arboretum, and to observe first hand research aimed at the goal of Better Living for All Ohioans!

The State Is the Campus for Agricultural Research and Development

Ohio's major soil types and climatic conditions are represented at the Research Center's 12 locations.

Research is conducted by 15 departments on more than 7000 acres at Center headquarters in Wooster, seven branches, Green Springs Crops Research Unit, Pomerene Forest Laboratory, North Appalachian Experimental Watershed, and The Ohio State University.

Center Headquarters, Wooster, Wayne County: 1953 acres

Eastern Ohio Resource Development Center, Caldwell, Noble County: 2053 acres

Green Springs Crops Research Unit, Green Springs, Sandusky County: 26 acres

Jackson Branch, Jackson, Jackson County: 502 acres

Mahoning County Farm, Canfield: 275 acres

Muck Crops Branch, Willard, Huron County: 15 acres

North Appalachian Experimental Watershed, Coshocton, Coshocton County: 1047 acres (Cooperative with Agricultural Research Service, U. S. Dept. of Agriculture)

Northwestern Branch, Hoytville, Wood County: 247 acres

Pomerene Forest Laboratory, Coshocton County: 227 acres

Southern Branch, Ripley, Brown County: 275 acres

Western Branch, South Charleston, Clark County: 428 acres